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To investigate how a child organizes new objects and how categories function for a chid, twelve 6- and twelve 8-year-olds were individually given several sorting tasks involving 21 three-dimensional nonsense objects. The child was exposed to all the objects; three objects were pointed out and withdrawn; and then the child was asked to describe them. The child grouped all 21 objects as he thought they should go together. After grouping, the items were mixed and the child was shown one of the three objects he described earlier. He stated to which group it belonged, and why. Again the object was withdrawn and the child described it and finally he regrouped the objects as they had previously been arranged. Part II of the study was divided into two conditions: (1) the child named five objects, and (2) no names were given. Eight new objects were added to the five and the child was asked to find the original five. The results indicated that (1) the sorting processes of the 8-year-olds were more homogeneous than those of the 6-year-olds, (2) the older children used more groups and recalled sorting better, (3) naming objects improved recall of the objects for 6-year-olds, but did not specifically help the 8-year-olds, and (4) categorization induced the 6-year-olds to notice new aspects of an object but to ignore previously noticed attributes of the objects, while 8-year-olds simply ignored the attributes of the objects. (WD)

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Concept Formation in Children: A Study Using Nonsense Stimuli and a Free-Sort Task

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CONCEPT FORMATION IN CHILDREN:

A STUDY USING NONSENSE STIMULI AND

A FREE-SORT TASK

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Abstract

Children of six and eight years of age freely sorted "nonsense" objects into piles. Several results from earlier studies were replicated including a preference for non-exhaustive sortings, a shift from a smaller to a larger number of piles, and a shift from color to shape descriptions with age. Labeling the objects helped six year olds, but not eight year olds, to find them later. The consonance of these results with those obtained earlier suggests that unstructured stimuli and unstructured sorting tasks may be substituted for more structured designs. Moreover, it was found that increasingly with age classification causes the children to ignore previously noticed properties of the objects. For six-year-olds sortings equally makes them aware of new properties of objects.

CONCEPT FORMATION IN CHILDREN: A STUDY USING NONSENSE STIMULI AND A FREE-SORT TASK[1, 2]

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Most previous studies of the development of classification and sorting behavior have used well-structured arrays of stimulus materials. In order to shed new light on the development of such processes, the present study uses an unstructured stimulus array consisting of nonsense objects and a free-sort task to ask children at six and eight years of age organize new objects in their experience. With this design it is possible to ask whether in fact a child perceives the world as structured in the ways that characterize more structured concept formation studies (Bruner, 1962). Since there are almost no restrictions on this task, one can ask first into how many piles (categories) children sort objects, whether children prefer to put all of the objects into some pile to make exhaustive sortings, what Inhelder and Piaget (1964, p. 21) have called "small partial alignments," and whether they force a structure which consists of a set of independent dimensions onto a new array of objects.

In addition, it is possible to replicate some of the results obtained in more structured task situations. Such replications will serve additionally as a check as to whether the present unstructured task is tapping the same cognitive system studied in more structured concept formation experiments. Since a qualitative analysis of unstructured piles is technically problematic, the device of having subjects describe an object was adopted. By this technique, one can look for a shift from color to shape descriptions (Inhelder

and Piaget, 1964, p. 126) and from a smaller to a larger number of piles (Inhelder and Piaget, 1964, p. 54). Further, one can see whether labeling of these nonsense objects is more facilitative of recall in six year olds than eight year olds, as has been found for other arrays (Kendler, 1963).

In addition to asking "how" a child organizes new objects, the present study also asks "why"--what is the function of categories for the six and eight year old child? Descriptions of an objects were obtained before and after sorting. The relative number of added and omitted descriptors at each age should suggest whether the function of categorization is primarily to add new information about an object or to allow a child to ignore previously obtained information. As a child gets older, it seems likely that categorization will increasingly serve to allow him to reduce his memory load by enabling him to ignore previously noticed aspects of an object (Miller, 1956).

Method

Subjects

The subjects were a racially mixed predominantly middle class group of children attending a summer day camp at the Hyde Park Neighborhood Club in Chicago. There were twelve children, half male and half female, in each age group. The mean ages of the groups were 8.36 and 6.22

Materials

The materials were twenty-one three-dimensional nonsense objects (Figure 1) constructed with ordinary materials which, in most cases, were

shiny. They were just small enough for the younger children to hold in two hands. In general, they had a variety of streamers, bells, and baubles. Some made noise when shaken, some had moving parts. A picture of the array is in Figure 1. There is no question that the objects held the children's interest.

Insert Figure 1 here

Procedure

Each subject was tested individually. Before beginning the experiment, the subject was seated in front of the full array of stimuli and encouraged to play with the objects.

Then each of the three objects to be described was presented individually. The order of presentation was randomized for each child. After each object was removed, the child was asked to tell the experimenter everything that he noticed about the object. E repeated, asking, "Anything else?" until the child said, "No." The three sortings consisted of (1) all of the objects, (2) half of the objects, (3) the other half of the objects. The three sortings were presented in randomized order. For each sorting the following procedure was followed: The subject was first asked to "put together in piles all of the things that go together." Then one of the three originally described objects was presented and the subject was asked which pile it belonged to and why. The object was then removed and he was asked to describe it. Finally, the subject was asked to sort the same objects into the same piles as he did before. This same procedure was followed for all three sortings.

In the last part of the experiment, there were two sections, A and B. In Section A, five objects were presented and the subject was asked to give them names. Then eight more new objects were added and mixed with the original five objects and the subject was asked to find all of the objects he had previously named. In Section B, the same procedure was followed for five additional objects which were presented initially for inspection but which were not named. Sections A and B were presented in randomized order.

Results

Sortings

The free-sort was analyzed by a computer program[3] which looks for all possible clusters of two to seven objects within the sorted groups regardless of the size of those groups. Any set of objects of size two to seven which appear together in a sorted group is considered a cluster. Clusters which occur in the sortings of more than one person at a given age (which occur with a frequency greater than two) were considered in the following analysis. The number of such clusters was significantly greater in the sortings of the eight year olds (mean = 5) than in the six year olds (mean = 3.25) ($t = 2.1$, $p < .025$). The larger number of identical sortings in the eight year old group shows that the sortings of the twelve eight year olds are more homogeneous than are the sortings of the twelve six year olds.

We can infer from the number of objects omitted from the piles the nature of the sorting criterion used. If objects are omitted then we may conclude that the sorting categories were not considered by the subject to be

exhaustive. Six year olds omitted an average of 2.58 objects from their sortings while eight year olds omitted an average of 1.33 objects. In neither case were the sortings exhaustive.

An inference may be made from the number of piles as to whether subjects were using independent bipolar dimensions. Let us imagine the bipolar dimensions which underlie the sorting define a matrix, the cells of which correspond to the children's sorted piles. An odd number of filled cells, corresponding to an odd number of piles, means that some cell in the matrix is empty. A single empty cell is caused by a failure of some value of a dimension to combine with all values of another dimension. Such an empty cell is not possible if the subjects are sorting on the basis of independent dimensions. Hence, subjects sorting into an odd number of piles cannot be sorting on the basis of independent bipolar dimensions. Odd numbers of piles characterize 64% of the sortings of the six year olds, but only 36% of the sortings of the eight year olds. This suggests that as the child gets older he tends more often to perceive the world as classified on the basis of independent dimensions. Between the ages of six and eight, a child often does not characterize the world in terms of independent bipolar dimensions.

The number of groups was significantly greater in the older than in the younger subjects ($t = 1.91$, $p < .05$). The average group had a smaller number of elements in the older than in the younger subjects ($t = 1.9$, $p < .05$). Recall of sortings was significantly better in the eight year old than in the six year old subjects ($t = 2.15$, $p < .025$).

Labeling

In this part of the experiment there were two sections. In Section A subjects had to find objects they had previously named (labeled). In Section B subjects had to find objects previously examined but not labeled. Labeling

Insert Table 1 here

improves the performance of six year olds ($t = 2.48$, $p < .025$) but not that of eight year olds (Table 1). Furthermore, while the eight year olds recall unlabeled objects better than do the six year olds ($t = 2.48$, $p < .025$), they do not recall labeled objects better than do the six year olds. One way to improve performance of six year olds but not of eight year olds is to provide a verbal label.

Object Descriptions

The total number of distinct elements in the descriptions for subjects at the two ages was counted. Six year old subjects had a mean of 21.17 descriptive units while eight year olds had a mean of 46.58. The number of units in the descriptions of the older children was significantly greater than in those of the younger children ($t = 4.26$, $p < .001$).

Many of the descriptive elements related to color or shape. While the number of color descriptions used by six year old subjects was greater than that used by eight year olds, this difference was not significant ($t = 1.15$). However, the number of shape descriptions was significantly larger in the eight year old than in the six year old subject group ($t = 1.99$, $p < .05$).

(Table 2) Shape and color descriptions together accounted for 45% of the

Insert Table 2 here

descriptions at both ages.

The analysis of change in the descriptions before and after sorting should help to explain the function of categorization for children at this age (Table 3). In the six year old group there is an equal number of added and omitted descriptors. Hence the function of categorization for six year olds is

Insert Table 3 here

equally to give them new ways to look at things and to allow them to forget previously noticed aspects of things. For the older subjects, the number of omitted descriptors is greater than the number of added descriptors ($t = 3.36$, $p < .005$). The effect of categorization in eight year olds is primarily to cause them to ignore things that they previously noticed rather than to cause them to notice new things.

To compare the age groups it is necessary to divide all of the eight year old means by two since the eight year olds responded with twice as many descriptive items as did the six year olds (Table 4). Looking at the data in

Insert Table 4 here

this way shows the six year olds adding significantly more items ($t = 2.38$, $p < .025$) than the eight year olds and probably omitting fewer items ($t = 1.42$,

$p < .1$). At both ages categorization permits subjects to ignore attributes of the object. However, in six year olds it equally makes them aware of new properties of an object. By the time a child is eight years old, categorization predominantly serves to make him ignore attributes of an object and much less often serves to make him aware of new properties of an object.

Discussion

The facilitative effect of labeling in six year olds (but not in eight year olds), the shift from color to shape descriptions, and the shift from a smaller to a larger number of piles, with age, is in accord with other similar studies using different stimuli. The consonance of these results with those obtained earlier argues strongly for the usefulness of nonsense objects as stimuli.

It has been found that children do not choose exhaustive categories at either age and it has been suggested that the older children's categories are more exhaustive than those of the younger children. It has been shown that children in this age range do not impose a structure consisting of an independent set of dimensions onto new objects that they categorize. It is odd that with increasing age the imposed structure becomes more independent since the dimensions used to characterize objects in the real world are more often than not correlated. Further, by making a cluster analysis, it has been shown that the sorting behavior of the eight year olds is more homogeneous than that of the six year olds.

The most important new finding in this study relates to the function of categorization at different ages. Miller (1956) has said that categorization serves primarily to reduce memory load. It can be assumed that it is experience with objects of categorization that are novel that tends to overload memory in the child's ordinary experience. In this respect, the use of nonsense objects corresponds with the ordinary experience of the young child for whom common objects are novel. Since adults rarely encounter new objects, the nonsense objects used here might have a very different function for them than they have for children.

It has been found that at both ages studied here categorization induces the child to ignore attributes of the object that had been previously noticed. If the function of categorization were to reduce memory load, it might be expected that categorization would cause children to ignore attributes of an object. While for six year olds the function of categorization is equally to induce them to notice new aspects of an object, for eight year olds this function is much less important than the "forgetting" function. Hence, it may be suggested that in very young children categorization, when it occurs, can be used as a means to explore the environment while in older children categorization serves primarily as a means of reducing memory load by causing the child to ignore previously noticed aspects of the environment.

Footnotes

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3 The author is grateful to Mr. Donald Goldhammer of the University of Chicago for developing the program for these free-sort data.

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Table 1

Effect of Labeling on Six and Eight Year Old Subjects

	Section A (Label)	Section B (No Label)
Six Year Olds	4.83	3.67
Eight Year Olds	4.83	4.83

Table 2

Number of Color and Shape Descriptions for Six and Eight Year Old Subjects

	Color	Shape
Six Year Olds	1.500	0.166
Eight Year Olds	0.830	1.000

Table 3

Mean Number of Elements Added to and Omitted from Original Description after Sorting

	Added	Omitted
Six Year Olds	7.83	8.00
Eight Year Olds	10.42	22.33

Table 4

Mean Number of Elements Added to and Omitted from Original Description after Sorting

(Eight Year Old Responses Divided in Half)

	Added	Omitted
Six Year Olds	7.83	8.00
Eight Year Olds	5.21	11.17

Figure Captions

1. Nonsense Objects--Experimental Stimuli